Claims

[1] A recycling method of a mixed waste of polyester and polyamide, comprising:
(a) depolymerizing the mixed waste of polyester and polyamide;
(b) polycondensing the depolymerized product with a polyhydric alcohol to obtain a polyester-amide block polymer having an acid value of 1 to 150 mgKOH/g; and
(c) recovering the polyester-amide block polymer in a solid or solution state where the acid value is greater than 20 mgKOH/g, or recovering the polyester-amide block polymer in a solid state where the acid value is less than 20 mgKOH/g.

[2] the method according to claim 1, wherein step (a) includes
(a-1) reacting the mixed waste of polyester and polyamide with a solid resin dissolving agent to carry out first depolymerization; and
(a-2) reacting the depolymerized product with a polybasic acid to carry out a second depolymerization and addition reaction (Diels-Alder Reaction).

[3] the method according claim 2, wherein the solid resin dissolving agent is at least one selected from the group consisting of gum rosin, wood rosin, tall rosin, hydrogenated rosin, maleated rosin, rosin ester, pinene resin, dipentene resin, C5 petroleum resin, C9 petroleum resin, dammar resin, copal resin, DCPD resin, hydrogenated DCPD resin and maleated styrene resin.

[4] the method according claim 2, wherein the mixing ratio of the solid resin dissolving agent : mixed waste is in the range of 1:10 to 10:1, on the basis of weight ratio.

[5] the method according claim 2, wherein the polybasic acid is at least one selected from the group consisting of anhydrous phthalic acid, isophthalic acid, terephthalic acid, adipic acid, azelaic acid, sebacic acid, anhydrous tetrahydrophthalic acid, anhydrous maleic acid, fumaric acid, itaconic acid, trimellitic acid, anhydrous trimellitic acid, anhydrous pyromellitic acid, succinic acid, cyclohexane dicarboxylic acid, naphthalene dicarboxylic acid, dimeric acid and C6 - C25 fatty acid.

[6] the method according claim 2, wherein the polybasic acid is used in an amount of 1 to 70% by weight, based on the weight of the first depolymerization product.

[7] the method according claim 1, wherein steps (a) and (b) are carried out in the presence of 0.05 to 0.5% by weight of a reaction catalyst, based on the total weight of reactants.

[8] The method according to claim 1, wherein steps (a) and (b) are carried out in the range of 200 to 250°C.

[9] The method according to claim 1, wherein the polyhydric alcohol in step (b) is at least one selected from the group consisting of ethylene glycol, propylene glycol, 1,3-propanediol, 1,4-butanediol, 1,6-hexanediol, neopentyl glycol, diethylene glycol, dipropylene glycol, polyethylene glycol, alkylene oxide adduct of bisphenol A, trimethylol propane, glycerin, pentaerythritol, fatty acid mono-glyceride, and mono polyhydric alcoholide of fatty acid.

[10] The method according to claim 1, wherein the polyhydric alcohol in step (b) is used in an amount of 1 to 70% by weight, based on the weight of the de-polymerized product in step (a).

[11] The method according to claim 1, wherein the polyester-amide block polymer prepared in step (b) has a weight average molecular weight of 3,000 to 50,000.

[12] The method according to claim 1, wherein the polyester-amide block polymer prepared in step (b) has a softening point of 10 to 150℃.

[13] The method according to claim 1, wherein the polyester-amide block polymer solution in step (c) is obtained by a method comprising (c-1) reacting the polyester-amide polymer of step (b) with a basic compound to obtain a neutralized polyester-amide block polymer; and (c-2) dissolving the neutralized polyester-amide block polymer in water, a hydrophilic solvent or a mixture thereof.

[14] The method according to claim 13, wherein the basic compound is at least one selected from the group consisting of sodium hydroxide, potassium hydroxide, ammonium hydroxide, lithium hydroxide and organic amines.

[15] The method according to claim 13, wherein the basic compound is used in an amount of 1 to 30% by weight, based on the weight of the polyester-amide block polymer.

[16] The method according to claim 13, wherein the hydrophilic solvent is at least one selected from the group consisting of alcohols, ethers, acetone, diacetone alcohol, dimethyl formamide, dimethyl acetamide, tetrahydrofuran, ethyl cellosolve, propyl cellosolve, butyl cellosolve and N-methyl-2-pyrollidone.

[17] The method according to claim 13, wherein water, the hydrophilic solvent or a mixed solvent thereof is used in 1 to 10-times amount based on the weight of the neutralized polyester-amide block polymer.

[18] A recycling method of a mixed waste of polyester and polyamide, comprising:
(a) reacting the mixed waste of polyester and polyamide with a polyhydric alcohol to obtain a polyester-amide depolymerization product;
(b) reacting the depolymerized product with a polybasic acid, and poly-condensing the reaction product with the polyhydric alcohol to obtain a polyester-amide block polymer containing 2 or 3 carboxyl groups at chain ends

thereof and having an acid value of 1 to 150 mgKOH/g; and
(c) reacting the polyester-amide block polymer with a basic compound to obtain a polyester-amide block polymer in the form of a neutralized salt, followed by dispersing in water, a hydrophilic solvent or a mixed solvent thereof to obtain a water-soluble and water-dispersible polyester solution.

[19] The method according to claim 18, wherein the basic compound is at least one selected from the group consisting of sodium hydroxide, potassium hydroxide, ammonium hydroxide, lithium hydroxide and organic amines.

[20] The method according to claim 18, wherein the basic compound is used in an amount of 1 to 30% by weight, based on the weight of the polyester-amide block polymer in step (b).

[21] A recycling method of a mixed waste of polyester and polyamide, comprising:
(a) reacting the mixed waste of polyester and polyamide with a polyhydric alcohol to depolymerize the mixed waste, and stabilizing the resulting product with a depolymerization-stabilizing solid resin to obtain a stabilized polyester de-polymerization product;
(b) polycondensing the depolymerized product with a polybasic acid, dimethyl 5-sodium sulfoisophthalate (DMSSIP) or a mixture thereof, and adding an acid value-adjusting polyhydric alcohol to the resulting reaction product to obtain a polyester-amide block polymer; and
(c) recovering the polyester-amide block polymer in the form of an aqueous solution where the polymer is dissolved in water, in the form of an organic solution where the polymer is dissolved in a hydrophilic organic solvent, or in solid form.

[22] The method according to claim 21, wherein the depolymerization-stabilizing solid resin is at least one selected from the group consisting of gum rosin, wood rosin, tall rosin, hydrogenated rosin, maleated rosin, rosin ester, pinene resin, dipentene resin, C5 petroleum resin, C9 petroleum resin, dammar resin, copal resin, DCPD resin, hydrogenated DCPD resin and maleated styrene resin.

[23] The method according to claim 21, wherein the depolymerization-stabilizing solid resin is used in an amount of 1 to 100% by weight, based on the weight of the depolymerization product.

[24] The method according to claim 18 or 21, wherein the polyhydric alcohol is at least one selected from the group consisting of ethylene glycol, propylene glycol, 1,3-propanediol, 1,4-butanediol, 1,6-hexanediol, neopentyl glycol, diethylene glycol, dipropylene glycol, polyethylene glycol, alkylene oxide adduct of bisphenol A, trimethylol propane, glycerin, pentaerythritol, fatty acid mono-glyceride, and mono polyhydric alcoholide of fatty acid.

[25] The method according to claim 18 or 21, wherein the polybasic acid is at least one selected from the group consisting of anhydrous phthalic acid, isophthalic acid, terephthalic acid, adipic acid, azelaic acid, sebacic acid, anhydrous tetrahydrophthalic acid, anhydrous maleic acid, fumaric acid, itaconic acid, trimellitic acid, anhydrous trimellitic acid, anhydrous pyromellitic acid, succinic acid, cyclohexane dicarboxylic acid, naphthalene dicarboxylic acid, dimeric acid and C6-C25 fatty acids.

[26] The method according to claim 18 or 21, wherein the polybasic acid is used in an amount of 1 to 50% by weight, based on the weight of the depolymerization product in step (a).

[27] A recycling method of a mixed waste of polyester and polyamide, comprising:

(a) reacting a polyhydric alcohol with alkali metal sulfonate of aromatic dicarboxylic acid including dimethyl 5-sodium sulfoisophthalate (DMSSIP) to prepare a polyester oligomer;

(b) reacting the polyester oligomer with the mixed waste of polyester and polyamide to depolymerize the mixed waste, followed by subjecting the depolymerized mixed waste to polycondensation following transesterification to obtain a polyester-amide block polymer; and

(c) recovering the polyester-amide block polymer in the form of an aqueous solution where the polymer is dissolved in water, in the form of an organic solution where the polymer is dissolved in a hydrophilic solvent, or in solid form.

[28] The method according to claim 21 or 27, wherein the DMSSIP is mixed in an amount of 1 to 30% by weight, based on the weight of the polybasic acid, when the DMSSIP is used in admixture with the polybasic acid.

[29] The method according to claim 18, 21 or 27, wherein the hydrophilic solvent is at least one selected from the group consisting of alcohols, acetone, diacetone alcohol, dimethyl formamide, dimethyl acetamide, ethyl cellosolve, propyl cellosolve, butyl cellosolve, tetrahydrofuran and N-methyl-2-pyrollidone.

[30] The method according to claim 18, 21 or 27, wherein the hydrophilic solvent is used in an amount of 1 to 100% by weight, based on the weight of the polyester-amide block polymer in step (b).

[31] A recycling method of a mixed waste of polyester and polyamide, wherein the solid or liquid polymer product obtained by the method according to claim 1, 18, 21 or 27 is a polyester-amide block polymer having 1 to 90% by weight of polyamide blocks in the molecular structure thereof.

[32] A polyester-amide block polymer and method of producing the same, recycling a mixed waste of polyester and polyamide, wherein the water-soluble polyester-amide block polymer composition obtained by the method according to claim 1,

18, 21 or 27, is used as at least one of synthetic resin fine particles, microcapsules, adsorbents, polymerization toner binders, fiber processing agents, sizing agents for use in paper-making and paper strength agents, wastewater treatment agents, dispersants, cement admixtures, waterproofing agents, inkjet ink binders, epoxy resin curing agents and modifiers, water-dispersible epoxy resin curing agents and modifiers.

[33] The polyester-amide block polymer and method of producing the same, wherein the recycled solid polyester-amide block polymer obtained by the method according to claim 1, 18, 21 or 27, is used as a toner binder for electron photography prepared by a grinding method.

[34] The polyester-amide block polymer and method of producing the same, wherein the recycled solid polyester-amide block polymer or an organic solution of the polyester-amide block polymer dissolved in an organic solvent, obtained by the method according to claim 1, 18, 21 or 27, is used as at least one of printer inks, coating materials, powder paints, adhesives, hot melt adhesives and waterproofing agents.

[35] A recycling method of a mixed waste of polyester and polyamide, comprising:
(a) reacting the mixed waste of polyester and polyamide with monoglycerides of fatty acids and mono polyhydric alcoholides of fatty acids to depolymerize the mixed waste, thereby obtaining a depolymerization composition;
(b) adding a polybasic acid and a polyhydric alcohol to the depolymerized composition to carry out polycondensation, thereby obtaining an oil-modified alkyd resin containing a polyester-amide; and
(c) dissolving the oil-modified alkyd resin containing the polyester-amide in a organic solvent such as naphtha or xylene, thereby recovering the resulting organic solution of the alkyd resin.

[36] The polyester-amide block polymer and method of producing the same, wherein the oil-modified alkyd resin containing the recycled polyester-amide block polymer obtained by the method according to claim 35 is used as at least one of printer ink and alkyd resin for paint.

[37] The method according to claim 18, wherein the depolymerized product produced in step (a) is reacted with a polybasic acid and polyhydric alcohol to obtain a polyester-amide polyol having an acid value of 1 to 10 mgKOH/g and a hydroxyl value of 5 to 200 mgKOH/g.

[38] The method according to claim 37, wherein the polyester-amide polyol having an acid value of 1 to 10 mgKOH/g and a hydroxyl value of 5 to 200 mgKOH/g is reacted with diisocyanate to obtain a polyurethane resin.

[39] The method according to claim 18, wherein an ethylenic vinyl monomer

containing a polymerization inhibitor is added and dissolved in the polyester-amide block polymer produced in step (b) to obtain a crosslinking curable unsaturated polyester amide resin.